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13 ABSTRACT *(Maximum 200 words)*

This presentation gives an approximate method that allows vertical polarization and sea surface roughness effects to be included in parabolic equation (PE) radio wave propagation models. This method was implemented in the hybrid Radio Physical Optics (RPO) propagation model, and several comparisons of RPO results to waveguide results are presented.

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AN APPROXIMATE MODEL FOR VERTICAL POLARIZATION AND SURFACE ROUGHNESS USING THE PARABOLIC EQUATION

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An approximate method is presented that allows vertical polarization and sea surface roughness effects to be included in parabolic equation (PE) radio wave propagation models. This method was implemented in the hybrid Radio Physical Optics (RPO) propagation model, and several comparisons of RPO results to waveguide results are presented.

The simplest and fastest running PE models use fast Fourier sine transforms. These models give exact results for horizontal polarization, but only approximate results for vertical polarization. In addition, there is no known simple method to correctly simulate rough sea surface effects in PE models using sine transforms. For low elevation angles, waveguide models show vertical polarization and rough surface effects to be important primarily for surface duct or surface-based duct conditions, because of the strong interaction between the ducting and reflecting mechanisms. The method presented here is an empirical model that makes simple adjustments to the PE method for ducting cases, such that the PE results match the waveguide results.

The PE method is modified to account for surface-interaction loss by multiplying the magnitude of the lowest PE field value by a factor between 0 and 1 just prior to each PE range step. Comparisons of this technique show remarkably good matches to waveguide results, provided the proper loss factor is applied. Several methods have been used to determine the appropriate loss factor based on the modified refractivity profile for the duct. The figure below shows propagation loss versus height for a strong evaporation duct for the cases of horizontal and vertical polarizations over a smooth sea, and for vertical polarization over rough seas corresponding to wind speeds of 10 and 20 meters per second.